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P2 1087577

THE UNITED STATES OF AMERICA

TO ALL TO WHOM THESE PRESENTS SHALL COME:

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office

December 09, 2003

THIS IS TO CERTIFY THAT ANNEXED HERETO IS A TRUE COPY OF THE BELOW IDENTIFIED INTERNATIONAL APPLICATION AS ORIGINALLY FILED AND ANY CORRECTIONS THERETO FROM THE RECORDS OF THE UNITED STATES PATENT AND TRADEMARK OFFICE ACTING AS A RECEIVING OFFICE UNDER THE PATENT COOPERATION TREATY.

APPLICATION NUMBER: ***PCT/US01/23163***
FILING DATE: ***July 19, 2001***

By Authority of the
COMMISSIONER OF PATENTS AND TRADEMARKS

P. R. Grant

P. R. GRANT
Certifying Officer

TRANSMITTAL LETTER TO THE UNITED STATES RECEIVING OFFICE

Date	July 19 2001
International Application No.	PCT/US 01/ 22 [illegible]
Attorney Docket No.	P50-0057 PCT

I. Certification under 37 CFR 1.10 (if applicable)

JC03 Rec'd PCT/PTO 19 JUL 2001

EL449548399US	July19, 2001
Express Mail mailing number	Date of Deposit

I hereby certify that the application/correspondence attached hereto is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated above and is addressed to Assistant Commissioner for Patents, Washington, D.C. 20231.

Sylvia A. Ransom	Sylvia A. Ransom
Signature of person mailing correspondence	Typed or printed name of person mailing correspondence

II. ☒ New International Application

OIPE JC100 JUL 19 2001 PATENT & TRADEMARK OFFICE

TITLE	RUNFLAT INSERT FOR TIRES	Earliest priority date (Day/Month/Year)

SCREENING DISCLOSURE INFORMATION: In order to assist in screening the accompanying international application for purposes of determining whether a license for foreign transmittal should and could be granted and for other purposes, the following information is supplied. (Note: check as many boxes as apply):

A. ☐ The invention disclosed was **not** made in the United States.

B. ☒ There is no prior U.S. application relating to this invention.

C. ☐ The following prior U.S. application(s) contain subject matter which is related to the invention disclosed in the attached international application. *(NOTE: priority to these applications may or may not be claimed on form PCT/RO/101 (Request) and this listing does not constitute a claim for priority).*

application no.		filed on	
application no.		filed on	

D. ☐ The present international application ☐ is identical ☐ contains less subject matter than that found in the prior U.S. application(s) identified in paragraph C.

E. ☐ The present international application ☐ contains additional subject matter not found in the prior U.S. application(s) identified in paragraph C. above. The additional subject matter is found on pages [ ] and ☐ **DOES NOT ALTER** ☐ **MIGHT BE CONSIDERED TO ALTER** the general nature of the invention in a manner which would require the U.S. application to have been made available for inspection by the appropriate defense agencies under 35 U.S.C. 181 and 37 CFR 5.1. See 37 CFR 5.15

III. ☐ A Response to an Invitation from the RO/US. The following document(s) is (are) enclosed:

A. ☐ A Request for An Extension of Time to File a Response

B. ☐ A Power of Attorney (General or Regular)

C. ☐ Replacement pages:

pages		of the request (PCT/RO/101)	pages		of the figures
pages		of the description	pages		of the abstract
pages		of the claims			

D. ☐ Submission of Priority Documents

Priority document		Priority document	

E. ☐ Fees as specified on attached Fee Calculation sheet form PCT/RO/101 annex

IV. ☐ A Request for Rectification under PCT 91 ☐ **A Petition** ☐ **A Sequence Listing Diskette**

V. ☐ Other (please specify):

The person signing this form is the:		
☐	Applicant	E. Martin REMICK
☒	Attorney/Agent (Reg. No.) 45,038	Typed name of signer
☐	Common Representative	E. Martin Remick Signature

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For receiving Office use only

International Application No. PCT/US 01/23163

International Filing Date (19.07.01) 19 JUL 2001

PCT INTERNATIONAL APPLICATION RO/US

Name of receiving Office and "PCT International Application"

REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

Applicant's or agent's file reference *(if desired) (12 characters maximum)* P50-0057 PCT

Box No. I TITLE OF INVENTION

RUNFLAT INSERT FOR TIRES

Box No. II APPLICANT ☐ This person is also inventor

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

Societe de Technologie Michelin
23 rue Breschet
FR-63000, Clermont-Ferrand
France

Telephone No.
(864) 422-4134

Facsimile No.
(864) 422-3517

Teleprinter No.

Applicant's registration No. with the Office

State *(that is, country)* of nationality: FR

State *(that is, country)* of residence: FR

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☐ the United States of America only ☒ the States indicated in the Supplemental Box

Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

Michelin Recherche et Technique S.A.
Route Louis-Braille 10 et 12
CH-1763, Granges-Paccot
Switzerland

This person is:
☒ applicant only
☐ applicant and inventor
☐ inventor only *(If this check-box is marked, do not fill in below.)*

Applicant's registration No. with the Office

State *(that is, country)* of nationality: CH

State *(that is, country)* of residence: CH

This person is applicant for the purposes of: ☐ all designated States ☒ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

☒ Further applicants and/or (further) inventors are indicated on a continuation sheet.

Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE

The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as: ☒ agent ☐ common representative

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

REMICK, E. Martin
Michelin North America, Inc.
Intellectual Property Department
515 Michelin Road
Greenville, South Carolina 29605
United States of America

Telephone No.
(864) 422-4134

Facsimile No.
(864) 422-3517

Teleprinter No.

Agent's registration No. with the Office
45,038

☐ **Address for correspondence:** Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

Continuation of Box No. III FURTHER APPLICANTS AND/OR (FURTHER) INVENTORS

If none of the following sub-boxes is used, this sheet should not to be included in the request.

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

RHYNE, Timothy B.
114 Dellwood Drive
Greenville, South Carolina 29609
United States of America

This person is:
- ☐ applicant only
- ☒ applicant and inventor
- ☐ inventor only *(If this check-box is marked, do not fill in below.)*

Applicant's registration No. with the Office

State *(that is, country)* of nationality: US

State *(that is, country)* of residence: US

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

DEMINO, Kenneth W.
2816 Ranchwood Drive
Anderson, South Carolina 29621
United States of America

This person is:
- ☐ applicant only
- ☒ applicant and inventor
- ☐ inventor only *(If this check-box is marked, do not fill in below.)*

Applicant's registration No. with the Office

State *(that is, country)* of nationality: US

State *(that is, country)* of residence: US

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

CRON, Steven M.
525 McKinney Road
Simpsonville, South Carolina 29681
United States of America

This person is:
- ☐ applicant only
- ☒ applicant and inventor
- ☐ inventor only *(If this check-box is marked, do not fill in below.)*

Applicant's registration No. with the Office

State *(that is, country)* of nationality: US

State *(that is, country)* of residence: US

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

This person is:
- ☐ applicant only
- ☐ applicant and inventor
- ☐ inventor only *(If this check-box is marked, do not fill in below.)*

Applicant's registration No. with the Office

State *(that is, country)* of nationality:

State *(that is, country)* of residence:

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

☐ Further applicants and/or (further) inventors are indicated on another continuation sheet.

Box No. V DESIGNATION OF STATES *Mark the applicable check boxes below; at least one must be marked*

The following designations are hereby made under Rule 4.9(a):

Regional Patent

☒ **AP ARIPO Patent:** **GH** Ghana, **GM** Gambia, **KE** Kenya, **LS** Lesotho, **MW** Malawi, **MZ** Mozambique, **SD** Sudan, **SL** Sierra Leone, **SZ** Swaziland, **TZ** United Republic of Tanzania, **UG** Uganda, **ZW** Zimbabwe, and any other State which is a Contracting State of the Harare Protocol and of the PCT

☒ **EA Eurasian Patent:** **AM** Armenia, **AZ** Azerbaijan, **BY** Belarus, **KG** Kyrgyzstan, **KZ** Kazakhstan, **MD** Republic of Moldova, **RU** Russian Federation, **TJ** Tajikistan, **TM** Turkmenistan, and any other State which is a Contracting State of the Eurasian

☒ **EP European Patent:** **AT** Austria, **BE** Belgium, **CH & LI** Switzerland and Liechtenstein, **CY** Cyprus, **DE** Germany, **DK** Denmark, **ES** Spain, **FI** Finland, **FR** France, **GB** United Kingdom, **GR** Greece, **IE** Ireland, **IT** Italy, **LU** Luxembourg, **MC** Monaco, **NL** Netherlands, **PT** Portugal, **SE** Sweden, **TR** Turkey, and any other State which is a Contracting State of the European Patent Convention and of the PCT

☒ **OA OAPI Patent:** **BF** Burkina Faso, **BJ** Benin, **CF** Central African Republic, **CG** Congo, **CI** Côte d'Ivoire, **CM** Cameroon, **GA** Gabon, **GN** Guinea, **GW** Guinea-Bissau, **ML** Mali, **MR** Mauritania, **NE** Niger, **SN** Senegal, **TD** Chad, **TG** Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT *(if other kind of protection or treatment desired, specify on dotted line)* .....

National Patent *(if other kind of protection or treatment desired, specify on dotted line)*:

☒ **AE** United Arab Emirates
☒ **AG** Antigua and Barbuda
☒ **AL** Albania .....
☒ **AM** Armenia .....
☒ **AT** Austria .....
☒ **AU** Australia .....
☒ **AZ** Azerbaijan
☒ **BA** Bosnia and Herzegovina .....
☒ **BB** Barbados
☒ **BG** Bulgaria .....
☒ **BR** Brazil .....
☒ **BY** Belarus .....
☒ **BZ** Belize .....
☒ **CA** Canada
☒ **CH & LI** Switzerland and Liechtenstein
☒ **CN** China .....
☒ **CO** Colombia
☒ **CR** Costa Rica .....
☒ **CU** Cuba .....
☒ **CZ** Czech Republic .....
☒ **DE** Germany .....
☒ **DK** Denmark .....
☒ **DM** Dominica
☒ **DZ** Algeria .....
☒ **EE** Estonia .....
☒ **ES** Spain .....
☒ **FI** Finland .....
☒ **GB** United Kingdom
☒ **GD** Grenada
☒ **GE** Georgia .....
☒ **GH** Ghana .....
☒ **GM** Gambia
☒ **HR** Croatia .....
☒ **HU** Hungary .....
☒ **ID** Indonesia
☒ **IL** Israel .....
☒ **IN** India .....
☒ **IS** Iceland
☒ **JP** Japan .....
☒ **KE** Kenya .....
☒ **KG** Kyrgyzsta .....
☒ **KP** Democratic People's Republic of Korea .....
☒ **KR** Republic of Korea .....
☒ **KZ** Kazakhstan .....
☒ **LC** Saint Lucia
☒ **LK** Sri Lanka
☒ **LR** Liberia
☒ **LS** Lesotho .....
☒ **LT** Lithuania
☒ **LU** Luxembourg
☒ **LV** Latvia
☒ **MA** Morocco .....
☒ **MD** Republic of Moldova .....
☒ **MG** Madagascar .....
☒ **MK** The former Yugoslav Republic of Macedonia .....
☒ **MN** Mongolia
☒ **MW** Malawi .....
☒ **MX** Mexico .....
☒ **MZ** Mozambique
☒ **NO** Norway
☒ **NZ** New Zealand .....
☒ **PL** Poland .....
☒ **PT** Portugal .....
☒ **RO** Romania
☒ **RU** Russian Federation .....
☒ **SD** Sudan
☒ **SE** Sweden
☒ **SG** Singapore
☒ **SI** Slovenia .....
☒ **SK** Slovakia .....
☒ **SL** Sierra Leone .....
☒ **TJ** Tajikistan .....
☒ **TM** Turkmenistan .....
☒ **TR** Turkey .....
☒ **TT** Trinidad and Tobago .....
☒ **TZ** United Republic of Tanzania
☒ **UA** Ukraine .....
☒ **UG** Uganda .....
☒ **US** United States of America .....
☒ **UZ** Uzbekistan .....
☒ **VN** Viet Nam .....
☒ **YU** Yugoslavia .....
☒ **ZA** South Africa .....
☒ **ZW** Zimbabwe .....

Check-boxes below reserved for designating States which have become party to the PCT after issuance of this sheet:

☒ Ecuador ..... ☐ ..... ☐ .....
☒ Equatorial Guinea ..... ☐ ..... ☐ .....

Precautionary Designation Statement: In addition to the designations made above, the applicant also makes under Rule 4.9(b) all other designations which would be permitted under the PCT except any designation(s) indicated in the Supplemental Box as being excluded from the scope of this statement. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. *(Confirmation (including fees) must reach the receiving Office within the 15-month time limit.)*

1. *If, in any of the Boxes, except Boxes Nos VIII(i) to (v) for which a special continuation box is provided, **the space is insufficient** to furnish all the information: in such case, write "Continuation of Box No...." (indicate the number of the Box) and furnish the information in the same manner as required according to the captions of the Box in which the space was insufficient, in particular:*

(i) ***if more than two persons are to be indicated as applicants and/or inventors** and no "continuation sheet" is available: in such case, write "Continuation of Box No. III" and indicate for each additional person the same type of information as required in Box No. III. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below;*

(ii) *if, in Box No. II or in any of the sub-boxes of Box No. III, the indication **"the States indicated in the Supplemental Box"** is checked: in such case, write "Continuation of Box No. II" or "Continuation of Box No. III" or "Continuation of Boxes No. II and No. III" (as the case may be), indicate the name of the applicant(s) involved and, next to (each) such name, the State(s) (and/or, where applicable, ARIPO, Eurasian, European or OAPI patent) for the purposes of which the named person is applicant;*

(iii) *if, in Box No. II or in any of the sub-boxes of Box No. III, **the inventor or the inventor/applicant is not inventor for the purposes of all designated States or for the purposes of the United States of America:** in such case, write "Continuation of Box No. II" or "Continuation of Box No. III" or "Continuation of Boxes No. II and No. III" (as the case may be), indicate the name of the inventor(s) and, next to (each) such name, the State(s) (and/or, where applicable, ARIPO, Eurasian, European or OAPI patent) for the purposes of which the named person is inventor;*

(iv) *if, in addition to the agent(s) indicated in Box No. IV, there are **further agents**: in such case, write "Continuation of Box No. IV" and indicate for each further agent the same type of information as required in Box No. IV;*

(v) *if, in Box No. V, the name of any State (or OAPI) is accompanied by the indication **"patent of addition,"** or **"certificate of addition,"** or if, in Box No. V, the name of the United States of America is accompanied by an indication **"continuation"** or **"continuation-in-part"**: in such case, write "Continuation of Box No. V" and the name of each State involved (or OAPI), and after the name of each such State (or OAPI) , the number of the parent title or parent application and the date of grant of the parent title or filing of the parent application;*

(vi) *if, in Box No. VI, there are **more than five earlier applications whose priority is claimed**: in such case, write "Continuation of Box No. VI" and indicate for each additional earlier application the same type of information as required in Box No. VI.*

2. *If, with regard to the **precautionary designation statement** contained in Box No. V, the applicant wishes to exclude any State(s) from the scope of that statement: in such case, write "Designation(s) excluded from precautionary designation statement" and indicate the name or two-letter code of each State so excluded.*

Continuation of Box II

Societe de Technologie Michelin is the Applicant for all the designated states except Canada, Mexico and the United States of America.

Box No. VI PRIORITY CLAIM

The priority of the following earlier application(s) is hereby claimed:

Filing date of earlier application *(day/month/year)*	Number of earlier application	Where earlier application is:		
		national application: country	regional application:* regional Office	international application: receiving Office
item (1)				
item (2)				
item (3)				
item (4)				
item (5)				

☐ Further priority claims are indicated in the Supplemental Box.

The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) *(only if the earlier application was filed with the Office which for the purposes of this international application is the receiving Office)* identified above as:

☐ all items ☐ item (1) ☐ item (2) ☐ item (3) ☐ item (4) ☐ item (5) ☐ other, see Supplemental Box

* *Where the earlier application is an ARIPO application, indicate at least one country party to the Paris Convention for the Protection of Industrial Property or one Member of the World Trade Organization for which that earlier application was filed (Rule 4.10(b)(ii))*: .....

.....

Box No. VII INTERNATIONAL SEARCHING AUTHORITY

Choice of International Searching Authority (ISA) *(if two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used)*:

ISA/ EP.....

Request to use results of earlier search; reference to that search *(if an earlier search has been carried out by or requested from the International Searching Authority)*:

Date *(day/month/year)* Number Country (*or regional Office*)

Box No. VIII DECLARATIONS

The following **declarations** are contained in Boxes Nos. VIII (i) to (v) *(mark the applicable check-boxes below and indicate in the right column the number of each type of declaration)*: Number of declarations

☐ Box No. VIII (i)	Declaration as to the identity of the inventor	:
☐ Box No. VIII (ii)	Declaration as to the applicant's entitlement, as at the international filing date, to apply for and be granted a patent	:
☐ Box No. VIII (iii)	Declaration as to the applicant's entitlement, as at the international filing date, to claim the priority of the earlier application	:
☐ Box No. VIII (iv)	Declaration of inventorship (only for the purposes of the designation of the United States of America)	:
☐ Box No. VIII (v)	Declaration as to non-prejudicial disclosures or exceptions to lack of novelty	:

 PCT/US 01/23102

Box No. IX CHECK LIST; LANGUAGE OF FILING

This international application **contains:**

(a) the following number of **sheets in paper form:**

request (including declaration sheets)	:	6
description (excluding sequence listing part)	:	13
claims	:	4
abstract	:	1
drawings	:	7
Sub-total number of sheets	:	31
sequence listing part of description *(actual number of sheets if filed in paper form, whether or not also filed in computer readable form; see (b) below)*	:	
Total number of sheets	:	31

(b) sequence listing part of description filed in **computer readable form**

(i) ☐ only (under Section 801 (a)(i))

(ii) ☐ in addition to being filed in paper form (under Section 801 (a)(ii))

Type and number of carriers (diskette, CD-ROM, CD-R or other) on which the sequence listing part is contained *(additional copies to be indicated under item 9(ii), in right column)*:

.....

This international application is **accompanied by** the following item(s) *(mark the applicable check-boxes below and indicate in right column the number of each item)*:

	Number of items
1. ☒ fee calculation sheet	1
2. ☒ original separate power of attorney	1
3. ☐ original general power of attorney	
4. ☒ copy of general power of attorney; reference number, if any:	2
5. ☐ statement explaining lack of signature	
6. ☐ priority document(s) identified in Box No. VI as item(s):	
7. ☐ translation of international application into *(language)*:	
8. ☐ separate indications concerning deposited microorganism or other biological material	
9. ☐ sequence listing in computer readable form (indicate also type and number of carriers (diskette, CD-ROM, CD-R or other))	
(i) ☐ copy submitted for the purposes of international search under Rule 13*ter* only (and not as part of the international application)	
(ii) ☐ *(only where check-box (b)(i) or (b)(ii) is marked in left column)* additional copies including, where applicable, the copy for the purposes of international search under Rule 13*ter*	
(iii) ☐ together with relevant statement as to the identity of the copy or copies with the sequence listing part mentioned in left column	
10. ☐ other *(specify)*:	

Figure of the drawings which should accompany the abstract: 3

Language of filing of the international application: English

Box No. X SIGNATURE OF APPLICANT, AGENT OR COMMON REPRESENTATIVE

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).

E. Martin Remick
REMICK, E. Martin, Agent for the Applicants

Timothy B. Rhyne
RHYNE, Timothy B. Inventor

Kenneth W. DeMino
DEMINO, Kenneth W. Inventor

Steven M. Cron
CRON, Steven M. Inventor

(19.07.01)

For receiving Office use only

1. Date of actual receipt of the purported international application:	JC03 Rec'd PCT/PTO 19 JUL 2001
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:	
4. Date of timely receipt of the required corrections under PCT Article 11(2):	
5. International Searching Authority (if two or more are competent): ISA/EP	6. ☐ Transmittal of search copy delayed until search fee is paid

2. Drawings:
☐ received:
☐ not received:

For International Bureau use only

Date of receipt of the record copy by the International Bureau:

PCT

FEE CALCULATION SHEET

Annex to the Request

For receiving Office use only

International Application No. PCT/US 01/23163

Date stamp of the receiving Office (19.07.01) 19 JUL 2001

Applicant's or agent's file reference: P50-0057 PCT

Applicant: **Societe de Technologie Michelin and Michelin Recherche et Technique S.A.**

CALCULATION OF PRESCRIBED FEES

1. TRANSMITTAL FEE	240.00 T	240
2. SEARCH FEE	846.00 S	846

International search to be carried out by: ISA/EP

(If two or more International Searching Authorities are competent to carry out the international search, indicate the name of the Authority which is chosen to carry out the international search.)

3. INTERNATIONAL FEE

Basic Fee

Where item (b) of Box No. IX applies, enter **Sub-total number of sheets**
Where item (b) of Box No. IX does not apply, enter **Total number of sheets** } 31

b1 first 30 sheets	382.00 b1	382
b2 1 (number of sheets) x 9.00 (fee per sheet) =	9.00 b2	9
b3 additional component (only if sequence listing part of description is filed in computer readable form under Section 801(a)(i), or both in that form and on paper, under Section 801(a)(ii)): 400 x ____ (fee per sheet) =	0.00 b3	
Add amounts entered at b1, b2 and b3 and enter total at B	391.00 B	391

Designation Fees

The international application contains 111 designations.

6 (number of designation fees payable *(maximum 6)*)	x	82.00 (amount of designation fee)	=	492.00 D → 492

Add amounts entered at B and D and enter total at I	883.00 I	883
4. FEE FOR PRIORITY DOCUMENT *(if applicable)*	0.00 P	
5. TOTAL FEES PAYABLE Add amounts entered at T, S, I and P, and enter total in the TOTAL box	1,969.00 TOTAL	1969

☐ The designation fees are not paid at this time.

MODE OF PAYMENT

☒ authorization to charge ☐ postal money order ☐ cash ☐ coupons

☐ cheque ☐ bank draft ☐ revenue stamps ☐ other *(specify)*:

AUTHORIZATION TO CHARGE (OR CREDIT) DEPOSIT ACCOUNT

(This mode of payment may not be available at all receiving Offices)

Receiving Office: RO/ US

☒ Authorization to charge the total fees indicated above.

Deposit Account No.: 13-3085

☒ *(This check-box may be marked only if the conditions for deposit accounts of the receiving Office so permit)* Authorization to charge any deficiency or credit any overpayment in the total fees indicated above.

Date: July 19, 2001

Name: E. Martin REMICK

☐ Authorization to charge the fee for priority document.

Signature: E. Martin Remick

PCT

POWER OF ATTORNEY

(for an international application filed under the Patent Cooperation Treaty)

(PCT Rule 90.4)

The undersigned applicant(s) *(Names should be indicated as they appear in the request):*

RHYNE, Timothy B.
DEMINO, Kenneth W.
CRON, Steven M.

hereby appoints (appoint) the following person as: ☒ agent ☐ common representative

Name and address
(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)

REMICK, E. Martin
Michelin North America, Inc.
Intellectual Property Department
515 Michelin Road
Greenville, South Carolina 29605
United States of America

to represent the undersigned before

☒ all the competent International Authorities
☐ the International Searching Authority only
☐ the International Preliminary Examining Authority only

in connection with the international application identified below:

Title of the invention: RUNFLAT INSERT FOR TIRES

Applicant's or agent's file reference: P50-0057 PCT

International application number (if already available):

filed with the following Office United States Patent and Trademark Office as receiving Office and to make or receive payments on behalf of the undersigned.

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Date: July 19, 2001

PCT

GENERAL POWER OF ATTORNEY

(for several international applications filed under the Patent Cooperation Treaty)

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Signature(s) *(where there are several persons, each of them must sign; next to each signature, indicate the name of the person signing and the capacity in which the person signs, if such capacity is not obvious from reading this power):*

Societe de Technologie Michelin

Michel ROLLIER, Secretary

Date: May 15, 2000

PCT/IB 01 / 23163

PCT

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and to make or receive payments on behalf of the undersigned.

Signature(s) *(where there are several persons, each of them must sign; next to each signature, indicate the name of the person signing and the capacity in which the person signs, if such capacity is not obvious from reading this power):*

Date: August 9, 1999

GALLEY, Paul
Member of the Board

ATTESTATION

Le notaire **Olivier ANDREY** soussigné, à Fribourg et Estavayer-le-Lac,

atteste par la présente

que Monsieur **Paul GALLEY**, fils de Jules, né le 5 août 1946, de nationalité suisse, marié, domicilié à Villars-sur-Glâne (Suisse), Rte du Bugnon 12, est Membre unique de l'Administration de la société MICHELIN RECHERCHE ET TECHNIQUE S.A., dont le siège est à Granges-Paccot (Canton de Fribourg / Suisse), Route Louis-Braille 10 et 12, qu'il est titulaire de la signature individuelle, ainsi qu'il appert des inscriptions faites au Registre du commerce de la Sarine, à Fribourg

et

que la signature ci-dessous apposée est bien celle de Monsieur Paul Galley.

Granges-Paccot, le 8 juin 1998.

CERTIFICATE

The undersigned, **Olivier ANDREY**, public notary of Fribourg and Estavayer-le-Lac,

hereby certifies

that Mr **Paul GALLEY**, son of Jules, born 5 August 1946, of Swiss nationality, married, residing in Villars-sur-Glâne (Switzerland), Rte du Bugnon 12, is the sole Member of the Management of MICHELIN RECHERCHE ET TECHNIQUE LTD, whose registered office is in Granges-Paccot (Canton of Fribourg / Switzerland), Route Louis-Braille 10 and 12 ; that he is entitled to sign for the company by his sole signature, as entered in the Sarine district Trade Register, in Fribourg

and

that the signature hereafter affixed is that of Mr Paul Galley.

Granges-Paccot, 8 June 1998.

OLIVIER ANDREY NOTAIRE

Paul Galley

Olivier Andrey

Annexe : extrait du registre du commerce de la Sarine, à Fribourg

Registre du commerce **FRIBOURG**

Registre principal

Numéro d'ordre	Fiche	Nature juridique	Report du	Date de l'inscription	Date de la radiation	Numéro du dossier
1 3	6148	1	Société anonyme		29.12.1988		

Réf.	Raison sociale ou nom	Réf.	Siège	Réf.	Domicile — Adresse	Réf.	Date des statuts	Réf.	Succursales
1	~~Michelin Recherche et Technique SA~~		(précéd. à Bâle)	1	c/o ~~Michelin-import-export S.A., Eurorésidence, Grand-Plaees-14A,~~		09.01.1963		
8	Michelin Recherche et Technique S.A. (Michelin Recherche et Technique AG) (Michelin Recherche et Technique Limited)	1	~~Fribourg~~	2	~~Eurorésidence-14A.~~	1	22.12.1988		
		6	Granges-Paccot	6	Route Louis-Braille 10 et 12	6	22.12.1993		
						8	21.6.1996		

Réf	Capital nominal	Capital libéré	Actions, prestations des associés, ressources
1	~~25'000'000.--~~	~~25'000'000.--~~	~~250'000 actions de Fr. 100.-, au porteur~~
8	25'000'000.-	25'000'000.-	2'500'000 actions de Fr. 10.-, nominatives.

Réf.	Apports en nature, reprise de biens, compensation de créances, avantages particuliers, responsabilité, versements supplémentaires
1	22'500'000.--, libérés par compensation de créances.

Réf.	But, observations
1	~~But : promouvoir, coordonner, faciliter et éventuellement financer la recherche fondamentale et la recherche d'application, les études réalisées dand le domaine des droits incorporels et industriels, ainsi que l'utilisation des résultats obtenus pouvant intéresser l'une ou l'autre des sociétés du groupe Michelin. Obtention et gestion de brevets et licences; conseils techniques; prise de participations.~~
1	Administration : un ou plusieurs membres. (Le conseil fixe le mode de signature)
1	Transfert du siège de Bâle)
8	But: promouvoir, coordonner, faciliter et éventuellement financer la recherche fondamentale et la recherche appliquée, les études réalisées dans le domaine des droits incorporels et industriels, ainsi que l'utilisation des résultats obtenus pouvant intéresser l'une ou l'autre des sociétés du groupe Michelin.
8	Convocation: lettre.

Réf.	Organes de publicité, autorité de surveillance (fondation)
1	Feuille Officielle Suisse du Commerce

PCT/US 01/23163
ROUS 27 AUG 2001

REGISTRE DU COMMERCE FRIBOURG

RUNFLAT INSERT FOR TIRES

BACKGROUND OF THE INVENTION

[01] The present invention relates to a runflat insert for mounting on a wheel rim and inside a pneumatic tire. In case of loss of inflation pressure from the tire, the insert is capable of taking up the vehicle loads. In particular this invention provides improved performance in load carrying, vehicle handling, and mass.

[02] Many solutions have been proposed to provide continued vehicle mobility after loss of inflation pressure in a pneumatic tire. One class of solutions involves fixing a rigid or semi-rigid insert to the wheel rim and inside the tire. Upon loss of inflation pressure, the vehicle is supported by load transmission from the portion of the insert contacting the inside of the tire directly through the insert structure to the wheel rim. This solution has limited capability to absorb sharp load inputs from the road, thereby operationally limiting the usefulness of the insert. A solution having a structurally supported runflat insert that delivers pneumatic tire-like performance would be a welcome performance improvement.

SUMMARY OF THE INVENTION

[03] The subject of the instant invention is a runflat insert having improved characteristics in load carrying, vehicle handling, mass, and shock transmission, wherein an outer, reinforced annular band is coupled with a sidewall structure having little resistance to compressive loads. Such a runflat insert for enabling a vehicle to run for limited duration on a deflated tire, is mounted in an assembly comprising a pneumatic tire and a wheel rim, and said insert is mounted inside the air cavity of the tire and secured to the wheel rim, said insert comprising:

a) an elastomeric outer contacting portion for contacting the interior surface of the tire during deflated operation of the tire, and

b) a reinforced annular band disposed radially inward of said outer contacting portion, wherein said band comprises an elastomeric shear layer, at least a first membrane adhered to the radially inward extent of said elastomeric shear layer and at least a second membrane adhered to the radially outward extent of said elastomeric shear layer, and

c) at least one sidewall portion extending radially inward from said contacting portion for connecting said annular band to a base member fitted around the wheel rim for securing said insert to the rim, and

d) at least one carcass layer adhered to said annular band, and said carcass extending radially inward from said annular band and anchored in said base member.

[05] When the vehicle tire deflates and/or the tire deflects sufficiently, the insert contacts the interior surface of the tire. The applied load flattens the annular band. The deformation of the band causes tensile forces to develop in that portion of the sidewall that is out of contact with the tire. The vehicle wheel effectively hangs from the annular band by the sidewall portions. The sidewall portion is essentially inextensible in tension, but has little resistance to compressive buckling. Conversely, in rigid or semi-rigid inserts, the inserts support the load by compression in the portion of insert in contact with the interior surface of the tire.

[06] Runflat inserts may be tightly fixed to the wheel rim or require the use of extra material or spacers to maintain proper lateral location of the insert on the rim. In the instant invention, the base member has a high resistance to rotation about a longitudinal axis. The base member may have monolithic cores comprising a generally rectangular cross-section having a width of about 5% of the section width of the insert, and the core has a height equal to about 50 percent of its width. Alternatively, the core may comprise one of several arrangements of reinforcing wires. When this base member structure is coupled with radially oriented sidewall portions, the insert has the advantage of maintaining a stable alignment on the rim and requires no additional internal spacers or reinforcements.

[07] Performance of the insert improves when the sidewall portion is biased to buckle advantageously in an axially outward direction when subjected to compressive loading. In the instant invention the sidewall is biased by an elastomeric wedge positioned in the sidewall essentially mid way between the first membrane and the base member. The wedge forces a curvature in the profile of the carcass layer. When the wedge is combined with the proper thickness of rubber on the outside of the carcass layer, the invention obtains the desired result of a consistent outward buckling of the sidewall in the region contacting the tire.

[08] A properly inflated pneumatic tire exerts a relatively uniform contact pressure against the road surface. When rigid or semi-rigid inserts deform under load to support the wheel, the contact pressure with the interior of the tire is non-uniform. However, the insert according to the invention, when deflected against the inside of a deflated tire, exhibits a relatively uniform contact pressure and a contact area similar to that of a pneumatic tire. This attribute exists when the ratio of the longitudinal tension and compression moduli of each of the membranes to the shear modulus of the shear layer is at least 100:1. That is to say that the membranes behave as essentially inextensible and deformation of the annular band is accommodated by shear strain in the elastomeric shear layer.

[09] Each membrane is comprised of a pair of biased cord-reinforced layers with the cords arranged at an angle of about 10 degrees to about 20 degrees with the centerline of the insert. The elastomeric shear layer will have a shear modulus of elasticity between about 3 MPa and about 20 MPa. The shear layer preferably has low level of hysteresis with tangent delta less than or equal to than about 0.1.

[010] The invention permits the designer to adjust the effective contact pressure as a design parameter of the insert. The contact pressure is approximated by the product of the shear modulus of elasticity of the shear layer, times the radial thickness of the annular band, and divided by the radius of the outermost extent of the second membrane. This contact pressure

will normally be in the range of about 2 bar to about 6 bar. A contact pressure of about 3 bar yields a good compromise between the size and mass of the insert and vehicle performance.

[011] From the point of view of load capacity, the ideal insert may have a section width and a section height limited only by the requirement of non-contact with the tire during normal operation. In a preferred form of the invention, the insert has a section width between about 50% to about 70% of the tire section width, and a section height between about 40% to about 60% of the tire section height.

DESCRIPTION OF THE DRAWINGS

[012] The invention will be better understood by reference to the following non-limiting examples illustrated in the attached figures. The intent of these figures is to illustrate the significant structural characteristics of the invention. The figures are not drawn to scale.

[013] FIG. 1 shows a radial section of an assembly comprising the runflat insert 100 mounted on a wheel rim and inside a tire. Figure 1 shows the loaded assembly, with the tire in a deflated state.

[014] FIG. 2 shows a partial radial section of the runflat insert 100 having a high turnup carcass that overlaps the second membrane.

[015] FIG. 3 shows a partial radial section of a runflat insert 200 having a single carcass layer adhered to the first membrane and having a sidewall portion biased to buckle outward under compression.

[016] FIG. 4 shows a partial radial section of a runflat insert 300 wherein the carcass layers are discontinuous segments adhered to the annular band and having a sidewall portion biased to buckle outward under compression.

[017] FIG. 5 shows a partial radial section of the base member of a runflat insert having a 3-2-1 arrangement of adjacent reinforcing wires.

[018] FIG. 6 shows a partial radial section of the base member of a runflat insert having a 4-3-2 arrangement of adjacent reinforcing wires.

[019] FIG. 7 shows a partial radial section of the base member of a runflat insert having a monolithic reinforcement.

[020] FIG. 8 shows an imprint of the contact area of the runflat insert 300 as compared to an elastomeric insert of conventional construction.

[021] FIG. 9 shows a graph of applied load versus vertical deflection an assembly of an inflated tire, a rim and the runflat insert 300 as compared to an elastomeric insert of conventional construction.

DETAILED DESCRIPTION OF THE INVENTION

[022] The invention and its several variations will be better appreciated from the following detailed description. The Figures and detailed description disclose several exemplary illustrations of particular variations of the invention as of the invention. One skilled in the art will recognize that particular elements of these variations may be selected or combined to yield still further examples within the spirit and scope of the invention.

[023] The following nomenclature and definitions are common to all variations of the invention disclosed herein. Similar reference numbers are used throughout to describe the same element or material. Similar elements are not discussed in detail when disclosed in a subsequent variation of the invention.

[024] Definitions of terms:

"inner" or "inward" means toward the interior of the insert.

"outer" or "outward" mean towards the exterior of the insert.

"axial" refers to a direction that is parallel to the axis of rotation of the insert

"radial" refers to a direction perpendicular to the axis of rotation of the tire.

"Modulus" of elastomeric materials means the tensile modulus of elasticity measured at 10 percent elongation.

"Modulus" of the membranes means the tensile modulus of elasticity at 1 percent elongation multiplied by the effective thickness of the membrane.

"Shear Modulus" of elastomeric materials means the shear modulus of elasticity and is defined equivalent to one-third the tensile modulus of elasticity measured at 10 percent elongation.

"Hysteresis" means the tangent delta measured at 100 degrees Celsius under a 30 Hz, 50 percent peak-to-peak dynamic shear strain.

[025] Figure 1 shows a runflat insert 100 mounted as an assembly with specialized rim 10 and tire 20 for enabling a vehicle to run on a deflated tire. When the tire is fully inflated, the tire pneumatically supports the vehicle load, and the insert does not continuously contact the interior surface of the tire. However, as the inflation pressure of tire 20 decreases from normal operating conditions, the vertical deflection of tire 20 increases to the point where insert 100 contacts the inner surface of tire 20. Figure 1 shows the operating condition with an uninflated tire where deformation of the runflat insert 100 supports essentially the entire vehicle load. The fully deflated tire no longer provides significant load support, and the insert structurally supports the load.

[026] Figure 2 shows a more detailed view of the insert 100. Insert 100 has an overall section width W and a section height H; the latter defined as the distance between the mounting surface 11 of the wheel 10 and the outer contacting surface of the insert. Insert 100 has a sidewall height HS measured between the radially outward extent the bead core 141 and the radially interior surface of the insert. According to the variations of the invention disclosed herein, the radially outward extent of the sidewall height HS may correspond to either the carcass layer 131 or the first membrane 121. Sidewall thickness measurements are referenced to the axial direction. Thickness measurements for the outer contacting portion, membranes, and the shear layer are

referenced to the radial direction. The outer contacting portion 110 has a thickness T1, shear layer 125 has a thickness T2. and the annular band comprising the shear layer and the first and second membranes has a thickness T3.

[027] Insert 100 comprises the structure depicted in Figure 2. An elastomeric outer contacting portion 110 provides the load-bearing surface for contact with the interior surface of the tire. A reinforced annular band 120 is disposed radially inward from the contacting portion 110. The reinforced annular band 120 comprises a first membrane 121 adhered to the inner surface of an elastomeric shear layer 125, and a second membrane 123 adhered to the outer surface of the elastomeric shear layer 125. Sidewall portion 130 extends radially inward from the contacting portion 110 and the annular band 120. A base member 140 containing bead cores 141 fits around the wheel rim surface 11 and secures the insert to the rim in both inflated and deflated operation.

[028] Runflat insert 100 further comprises a carcass layer having a main portion 131 that is adhered to the radially inner surface of the first membrane 121 and extending between the bead members 140. The carcass layer has a turned up portion 132 folded around the bead core 141. The flexural stiffness of the reinforced annular band 120 improves when the turned up portion 132 of the carcass is adhered to the axially outer face of the band. In the form of the invention corresponding to runflat insert 100, the turned up portion 132 extends radially outward from the base member 140, adheres to the axially outer face of the band, and terminates in an axial overlap with the second membrane 123. This overlap facilitates fabrication of the insert on conventional tire building equipment. The overlap extends an axial distance L inward from the extremity of second membrane of about 10mm. In other forms of the invention, the turned up portion 132 may terminate without overlap, at the axial extremity of the second membrane 123, or at some lower radial location within the sidewall 130 or bead member 140.

[029] The tensile resistance of the carcass layer is sufficient when the linear stiffness per unit circumference, measured at the mid-height of the sidewall, of the carcass reinforcements and

surrounding elastomeric layers is at least 100 daN/mm. In the runflat insert 100, polyester cords comprise the reinforcement of the carcass layer 131, 132, but any material suitable as a tire reinforcement material may be used. In a non-pneumatic structure such as the runflat inserts disclosed herein, the average tensile force in each of the carcass reinforcing cords is significantly lower than in an inflated, pneumatic tire. Therefore, as segments of the sidewall rotate in and out of the contact region, there is an increased likelihood that compressive stress will occur in the carcass layer. For this reason, the most advantageous choice for carcass reinforcement material is one with good resistance to cyclic compressive loading.

[030] Experimentation with the runflat insert 100 has shown that elimination of the double layer carcass in the upper sidewall portion improves durability. Figure 3 shows such an improved version of the invention. An elastomeric outer contacting portion 210 provides the load-bearing surface for contact with the interior surface of the tire. A reinforced annular band 220 is disposed radially inward from the contacting portion 210. The reinforced annular band 220 comprises a first membrane 221 adhered to the inner surface of an elastomeric shear layer 225, and a second membrane 223 adhered to the outer surface of the elastomeric shear layer 225. Sidewall portion 230 extends radially inward from the contacting portion 210 and the annular band 220. Base member 240 containing bead cores 241 fits around the wheel rim surface 11 and secures the insert to the rim in both inflated and deflated operation.

[031] The inventors have recognized that the performance under cyclic stress of textile carcass materials improves when the carcass tension is maintained throughout each stress cycle. In a pneumatic tire, the inflation stress biases the carcass is in tension. In a non-pneumatic structure such as the runflat inserts disclosed herein, no such tension bias exists. Therefore, durability of the insert improves when the deformation of the carcass layer in the portion of the insert loaded against the tire minimizes the tendency for the carcass to undergo cyclic compressive stress.

[032] As a first means to achieve this performance improvement, runflat insert 200 has only a single carcass layer in the upper sidewall portion. Runflat insert 200 further comprises a carcass

layer having a main portion 231 that is adhered to the radially inner surface of the first membrane 221 and extending between the bead members 240. The carcass layer has a turned up portion 232 folded around the bead core 241. The turned up portion 232 extends radially outward from the base member 140 and terminates a radial distance HC above the bead core 241. Runflat insert 200 further improves durability by introducing a slight outward displacement C to the carcass layer 231. This displacement is assured by applying an extra elastomeric wedge 235 to the axially interior surface of carcass layer 231 and by proper specification of the sidewall thickness at the upper and lower extents of the wedge 235. Therefore, when the sidewall portion 230 experiences vertical compressive loads, the carcass is biased to buckle consistently in an axially outward direction. The effect of the wedge 235 and of the sidewall thickness serves to minimize the tendency of the carcass to experience cyclic compressive stress.

[033] The wedge 235 has a height HG that is between about 50 percent to about 80 percent, and preferably about 65 percent, of the sidewall height HS. The wedge 235 is positioned approximately midway within the sidewall portion 230. The displacement C of carcass layer 231 is defined as the axial distance between the centerline of the carcass layer 231 and a chord connecting the upper and lower extents of the wedge 235. The displacement C is greater than zero and less than or equal to about 8 percent of the sidewall height. C is preferably about 5 percent of the sidewall height HS. The wedge 235 has an axial thickness TG that may be greater or less than the displacement C of carcass 231. TG is between about 4 percent and about 10 percent, and preferably about 7 percent, of the sidewall height HS. Thickness measurements TB and TT specify the thickness of the sidewall material to the exterior of the carcass. TB is measured at the radially innermost extent of the wedge 235. TT is measured at the radially outermost extents of the wedge 235. TB and TT are each between about 4 percent and about 10 percent, and preferably about 8 percent, of the sidewall height HS. Runflat insert 200 was successfully constructed and evaluated using HS equal to 30 mm, C equal to 1.5 mm, HG equal to 20 mm, and TT, TB, and TG equal to 2 mm.

[034] Figure 4 shows a version of the invention optimized for load carrying. That is to say, an insert having improved load/deflection stiffness. Runflat insert 300 shares the structure of the reinforced annular band 325 common to runflat inserts 100 and 200 previously disclosed. However, runflat insert 300 has a unique carcass layer comprising at least a discontinuous carcass segment 331 anchored in the base member 340 and extending radially outward to the second membrane 321. The carcass segment 331 is adhered to an axially outermost extent of the reinforced annular band 320. That is to say, the carcass segment 331 extends radially outward at least to the axial extremity of the second membrane 321. As compared to runflat insert 200 shown in Figure 3, the carcass arrangement shown in Figure 4 for runflat insert 300 improves the load/deflection stiffness of the annular band 320. For ease of manufacturing, the carcass segment 331 may also overlap the second membrane 321 a distance L as previously described for the runflat insert 100 shown in Figure 2.

[035] The following aspects of the detailed description of the invention are common to any of the variations 100, 200, or 300 of the insert. For simplicity, each structural element references insert 100, although this shortcut is not intended in any way to limit the scope of this disclosure.

[036] The runflat inserts of the invention have bead members with a high resistance to rotation about a longitudinal axis. The resistance to rotation provides both stable axial alignment on the wheel surface 11 and good durability to flexure of the sidewall portions. Figures 5, 6, and 7 disclose three alternative arrangements of bead reinforcements. Any of the reinforcements 141, 142, or 143 apply to the variations of the insert 100, 200, or 300. Figures 5 and 6 show a typical arrangement consisting of a continuous winding of wire reinforcement. Figure 5 shows a three-layer arrangement 141 consisting of a winding of wire of about 1 mm and having a first layer of three wires, a second layer of two wires, and a third layer of one wire. The arrangement 142 of Figure 6 provides a higher degree of bead rigidity and consists of a winding having a three-layer arrangement of four, then three, then two wires for the respective layers. Figure 7 shows a preferred form having a monolithic reinforcement 143 of generally rectangular cross-section

having a width of at least 4 mm and height of at least 2 mm. Reinforcement 143 has a width of about 5% of the section width of the insert, and a height equal to about 50 percent of its width. The bead members of the non-pneumatic insert may have a lower tensile modulus and tensile strength than required for a pneumatic structure. In the instant invention, suitable materials for bead reinforcements 141, 142, or 143 should have a tensile modulus of at least about 100 GPa and a tensile yield strength of at least about 10 GPa.

[037] The runflat inserts 100, 200, or 300 have an annular band comprising first and second membranes adhered to the elastomeric shear layer. The preferred deformation of the band occurs when the ratio of the longitudinal tensile modulus of each of the membranes to the shear modulus of the shear layer is at least 100:1. According to one form of the invention, the first and second membranes have longitudinally oriented cord reinforcements. Preferably, each membrane, 121 or 123, comprises at least two layers of mutually oblique cord reinforcements forming an angle with the tire circumferential direction of between about 10 degrees to about 20 degrees. Equation (1) below estimates the longitudinal tensile modulus of a membrane using conventional tire belt materials:

$$E'_{MEMBRANE} = (2D+t)\frac{E_{RUBBER}}{2(1-\nu^2)}\left[\left(\frac{P}{P-D}\right)\frac{2-(1+\nu)SIN^2(2\alpha)}{SIN^4\alpha}+\left(\frac{t}{D}\right)\frac{1}{TAN^2\alpha}\left(\frac{1}{TAN^2\alpha}-\nu\right)\right] \quad (1)$$

Where: E_{rubber} = Tensile modulus of the elastomeric coating material
P = Cord pace (cord centerline spacing) measured perpendicular to the cord direction
D = Cord diameter
ν = Poisson's ratio for the elastomeric coating material
α = Cord angle with respect to the equatorial plan
t = Rubber thickness between cables in adjacent layers

Note that E' is the elastic modulus of the membrane times the effective thickness of the membrane

[038] The elastomeric shear layer 125 preferably has a shear modulus of elasticity between about 3 MPa and about 20 MPa. The shear layer has a low hysteresis given by tangent delta less than or equal to about 0.1. Shear layer 125 has a thickness T2 between about 4 mm and about 20 mm.

[039] An advantage of the instant invention is that the contact pressure during deflated operation between the insert and the tire is a design parameter that the designer may adjust. The contact pressure between the insert and the inside of the tire is given by the product of the shear modulus of elasticity of the shear layer times the radial thickness of the shear layer divided by the radius of the outermost extent of the second membrane. The insert delivers acceptable performance when the contact pressure is between about 2 bar and about 6 bar. In general, the contact pressure of the insert will be proportionately greater than the specified tire inflation pressure.

[040] The advantages of the runflat insert of the invention are further appreciated by the following experimental data. Figure 8 shows a comparison of the shape of the contact area for a molded, elastomeric insert and for the runflat insert 200 of the invention. The molded elastomeric insert is of the type described in US Patent 5,891,279 issued to Lacour. The molded, elastomeric insert has an average contact pressure of about 5.2 bar. The runflat insert 200 has a larger contact area and a contact shape that more closely resembles that of a pneumatic tire. Larger contact area gives a lower average contact pressure for a given load. Runflat insert 200 has a lower average contact pressure of about 3.6 bar. The insert 200 has a larger, rectangular contact shape that promotes more uniform loading of the insert on the interior of the tire for better durability and resistance to impact loads.

[041] The assembly comprising the insert of the invention gives deflated performance similar to when the pneumatic tire is inflated. A simple measurement of the load/deflection stiffness demonstrates this advantage. In this test, the reference insert and the insert of the invention were mounted as part of a pneumatic tire and wheel assembly. Figure 9 shows the results of a load/deflection test where the mounted assemblies were loaded on simulated curb. The tire was inflated to 2.0 bar. The resulting vertical force was recorded as a function of the deflection of the assembly (the downward displacement of the axis of the wheel). Figure 9 shows the curves of load versus deflection for the two inserts. As deflection increases from zero up to approximately

30–35 mm, the curves for both assemblies track the deflection of the inflated tire. As the deflection surpasses about 35 mm. tire. the insert begins to contact the interior surface of the tire. The assembly comprising the molded insert demonstrates a marked increase in the vertical stiffness of the system as shown by the rapid load increase with further deflection of the system. This rapid stiffening of the assembly comprising the elastomeric insert has the undesirable effect of forcing the vehicle suspension to accommodate any further deflection.

[042] However, Figure 9 clearly demonstrates that the assembly comprising the insert of the instant invention maintains a vertical stiffness that is remarkably similar to the original stiffness of the tire alone. Thus, the insert according to the invention avoids the negative effects of the undesirable impacts acting on the vehicle suspension.

[043] Applicant understands that many other variations are apparent to one of ordinary skill in the art from a reading of the above specification. These variations and other variations are within the spirit and scope of the instant invention as defined by the following appended claims.

We claim:

1. A runflat insert for enabling a vehicle to run on a deflated tire, mounted in an assembly comprising a pneumatic tire and a wheel rim, said insert being mounted inside the air cavity of the tire and secured to the wheel rim, said insert comprising:

a) an elastomeric outer contacting portion for contacting the interior surface of the tire during deflated operation of the tire, and

b) a reinforced annular band disposed radially inward of said outer contacting portion, wherein said band comprises an elastomeric shear layer, at least a first membrane adhered to the radially inward extent of said elastomeric shear layer and at least a second membrane adhered to the radially outward extent of said elastomeric shear layer, and

c) at least one sidewall portion extending radially inward from said contacting portion for connecting said annular band to a base member fitted around the wheel rim for securing said insert to the rim, and

d) at least one carcass layer adhered to said annular band, and said carcass layer extending radially inward from said annular band and anchored in said base member.

2. The runflat insert of claim 1, wherein said carcass layer is a continuous ply having a main portion adhered to said radially inner surface of second membrane and extending between said base members.

3. The runflat insert of claim 1, wherein said carcass layer comprises at least a discontinuous segment anchored in said base member and extending radially outward to said second membrane, and wherein said segment is adhered to an axially outermost extent of said reinforced annular band.

4. The runflat insert of claim 1, wherein said carcass layer axially overlaps said second membrane not more than 10 mm.

5. The runflat insert of claim 1 wherein an elastomeric wedge is adhered to the interior surface of said carcass layer in said sidewall, whereby said wedge biases said sidewall to buckle in an outward direction.

6. The runflat insert of claim 5 wherein said wedge has a radial height of about 50 percent to about 80 percent of the height of said sidewall.

7. The runflat insert of claim 5 wherein said wedge is positioned in said sidewall essentially midway between said first membrane and said base member.

8. The runflat insert of claim 5 wherein said carcass layer has an axially outward displacement from a chord connecting the upper and lower extents of said wedge.

9. The runflat insert of claim 8 wherein said displacement of said carcass layer is greater than zero and less than or equal to about 8 percent of the height of said sidewall.

10. The runflat insert of claim 5 wherein the thickness of said sidewall at the radially innermost extent of said wedge is between about 4 percent to about 10 percent of the height of said sidewall.

11. The runflat insert of claim 5 wherein the thickness of said sidewall at the radially uppermost extent of said wedge is between about 4 percent to about 10 percent of the height of said sidewall.

12. The runflat insert of claim 5 wherein the thickness of said wedge is between about 4 percent to about 10 percent of the height of said sidewall.

13. The runflat insert of claim 1 wherein said sidewall has a linear stiffness in tension of at least 100 daN/mm.

14. The runflat insert of claim 1 wherein said base member has a reinforcement material having a tensile modulus of at least about 100 GPa and a tensile yield strength of at least about 10 GPa.

15. The runflat insert of claim 14 wherein said base member has a monolithic reinforcement having a width of at least about 5 percent of a maximum section width of said insert and a height of about 50 percent of said width of said reinforcement.

16. The runflat insert of claim 14 wherein each of said base member has reinforcing cores arranged in a three-layer stack having a 4-wire by 3-wire by 2-wire configuration of wires having a diameter of about 1 mm.

17. The runflat insert of claim 14 wherein each of said base member has reinforcing cores arranged in a three-layer stack having a 3-wire by 2-wire by 1-wire configuration of wires having a diameter of about 1 mm.

18. The runflat insert of Claim 1 wherein a ratio of the longitudinal tensile modulus of each of said membranes to the shear modulus of said shear layer is at least 100:1.

19. The runflat insert of claim 18, wherein each of said membranes comprises at least one layer of essentially circumferentially oriented cord reinforcements.

20. The runflat insert of claim 18, wherein each of said membranes comprises at least two layers of mutually oblique cord reinforcements, and said cord reinforcements form an angle with the tire circumferential direction of between about 10 degrees and about 20 degrees.

21. The runflat insert of claim 1, wherein said elastomeric shear layer has a thickness between about 4 mm and about 20 mm.

22. The runflat insert of claim 1, wherein said elastomeric shear layer has a shear modulus of elasticity of between about 3 MPa and about 20 MPa.

23. The runflat insert of claim 22, wherein said elastomeric shear layer has a tangent delta of less than or equal to about 0.1.

24. The runflat insert of claim 1, wherein the product of the shear modulus of elasticity of said shear layer times the radial thickness of said shear layer divided by the radius of the outermost extent of said second membrane is between about 2 bar and about 6 bar.

25. The runflat insert of claim 24, wherein the product of the shear modulus of elasticity of said shear layer times the radial thickness of said shear layer divided by the radius of the outermost extent of said second membrane is about 3 bar.

26. The runflat insert of claim 1, wherein said insert has a maximum width between about 50 percent to about 70 percent of the tire section width.

27. The runflat insert of claim 1, wherein said insert has a section height between about 40 percent to about 60 percent of the section height of the tire.

ABSTRACT

A runflat insert 200 for enabling a vehicle to run for limited duration on a deflated tire 20, is mounted in an assembly comprising a pneumatic tire 20 and a wheel rim 10, and said insert is mounted inside the tire and secured to the wheel rim. The insert 200 has improved characteristics in load carrying, vehicle handling, mass, and shock transmission. Such a runflat insert 200 comprises an outer, reinforced annular band 220 that is coupled with a sidewall portion 230 having little resistance to compressive loads, and the sidewall portion 230 terminates in a base member 240 fitted around the wheel rim 10 for securing the insert 200 to the rim 10.

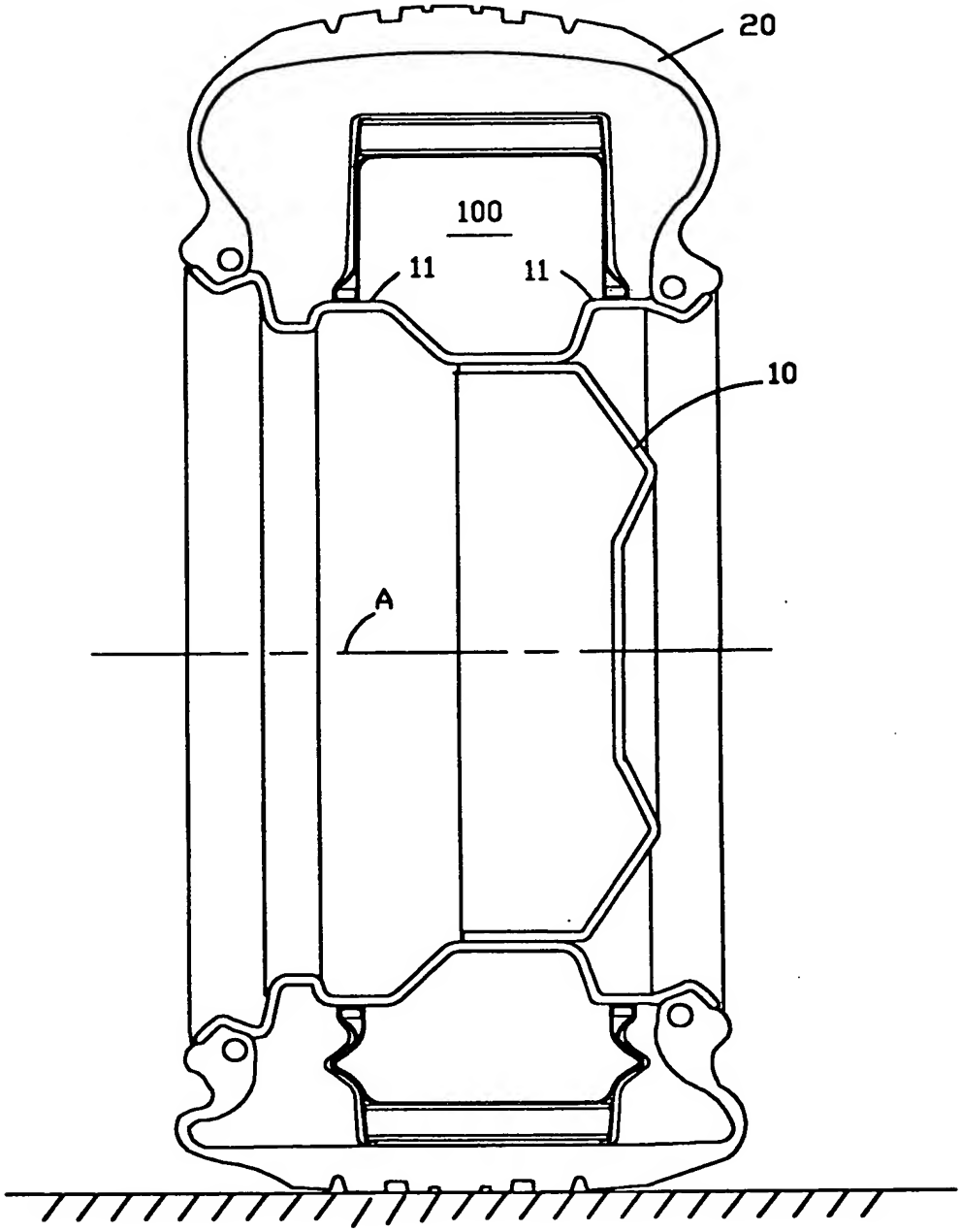


Fig. 1

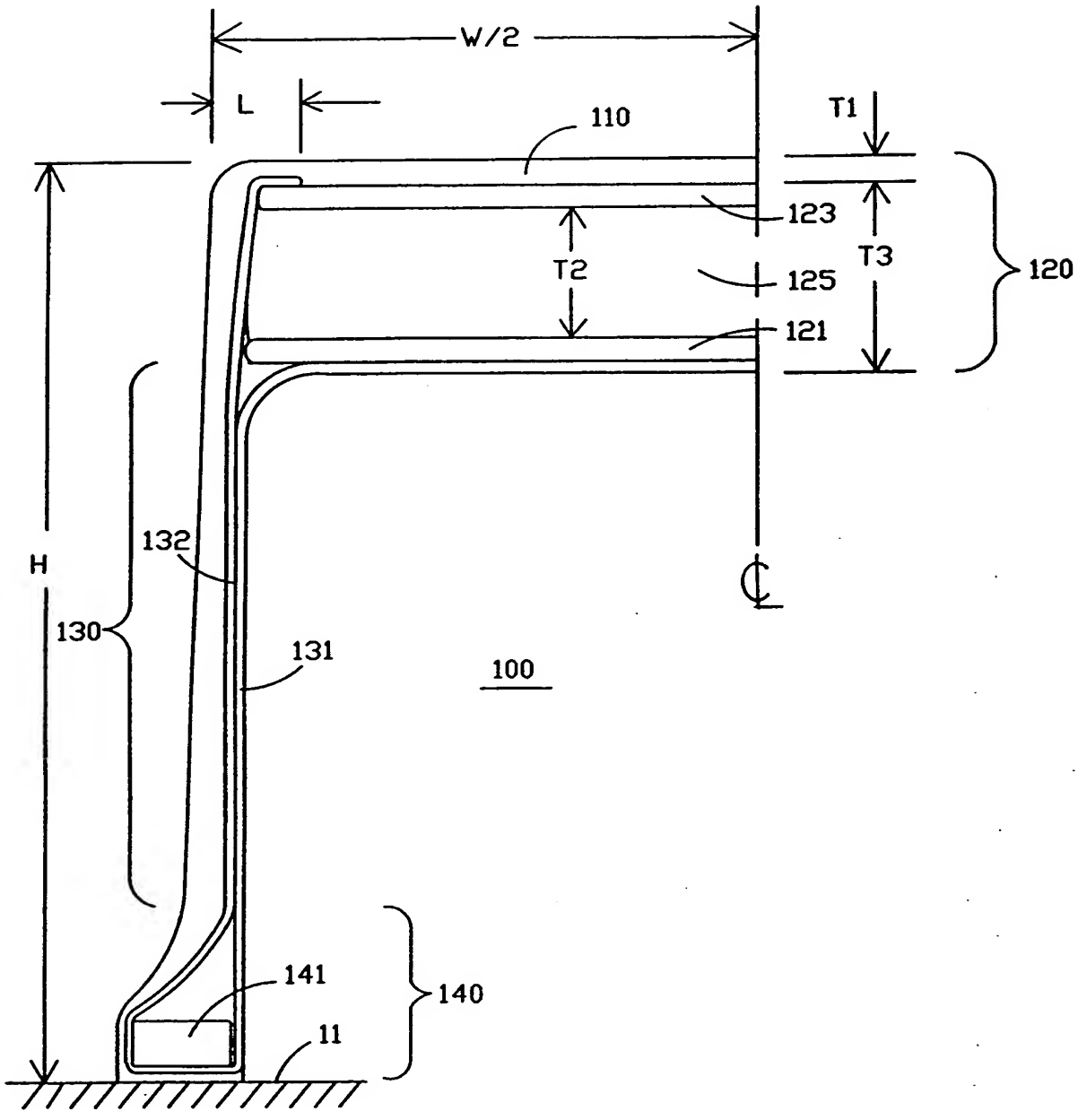
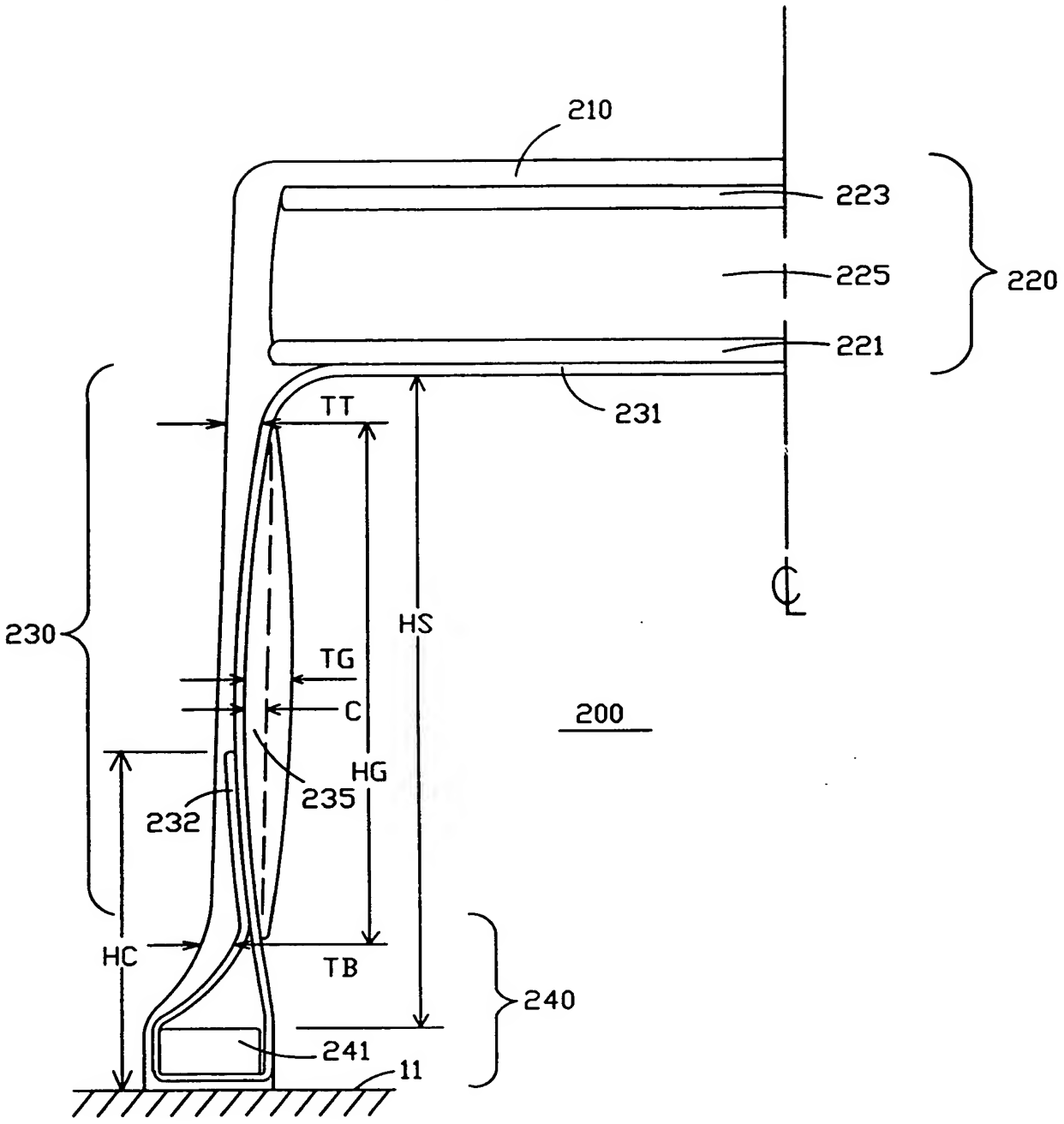


Fig. 2


210
223
225
220
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231
TT
230
HS
TG
C
200
HG
235
232
HC
TB
240
241
11

Fig. 3

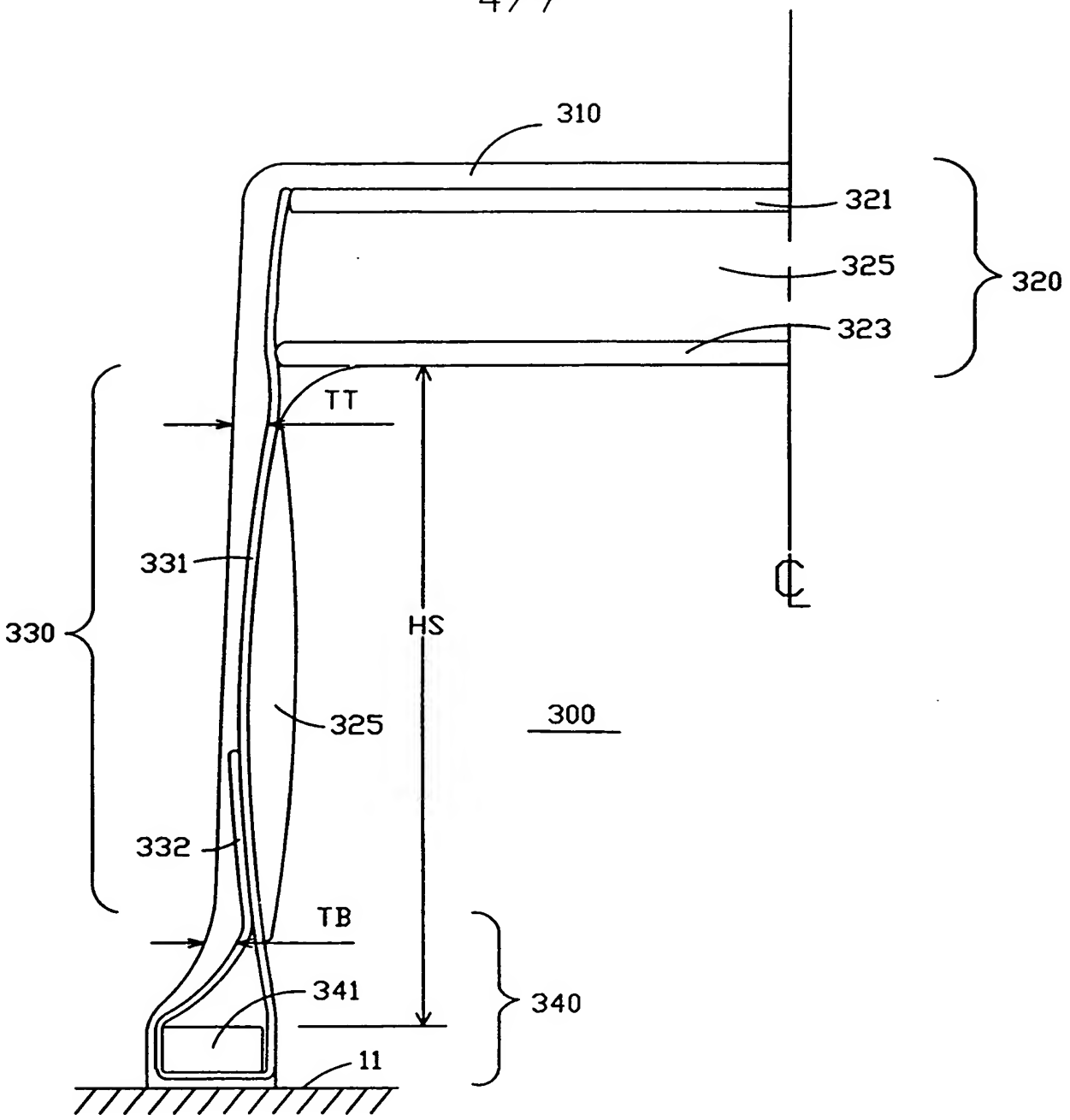


Fig. 4

Fig. 5

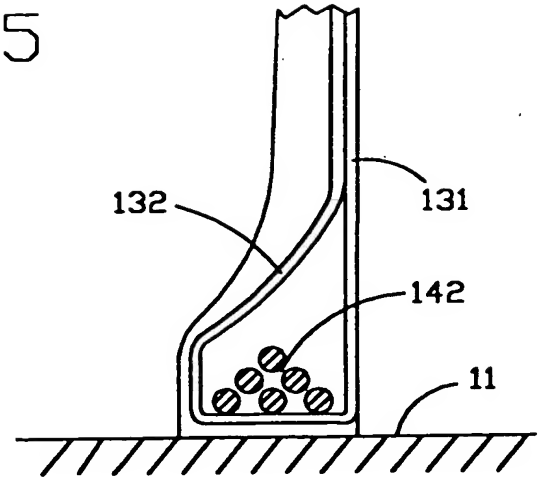


Fig.6

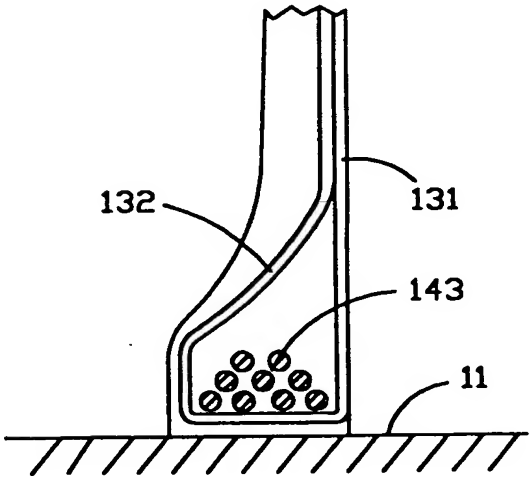
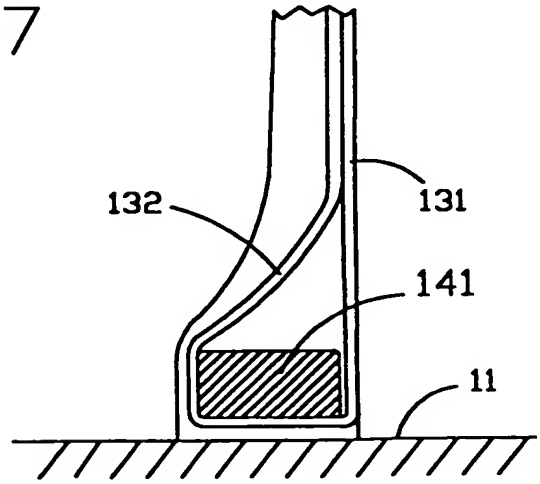
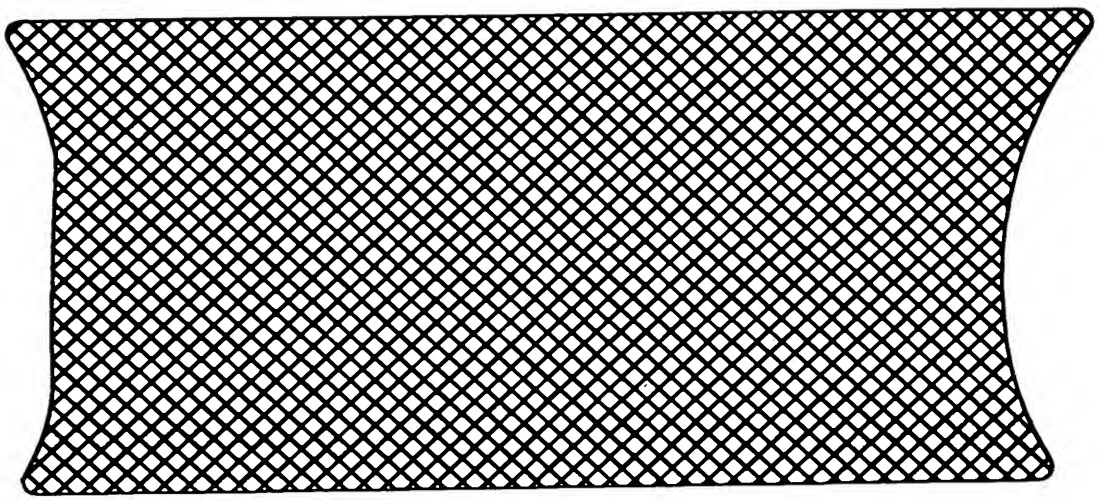


Fig. 7





INVENTION

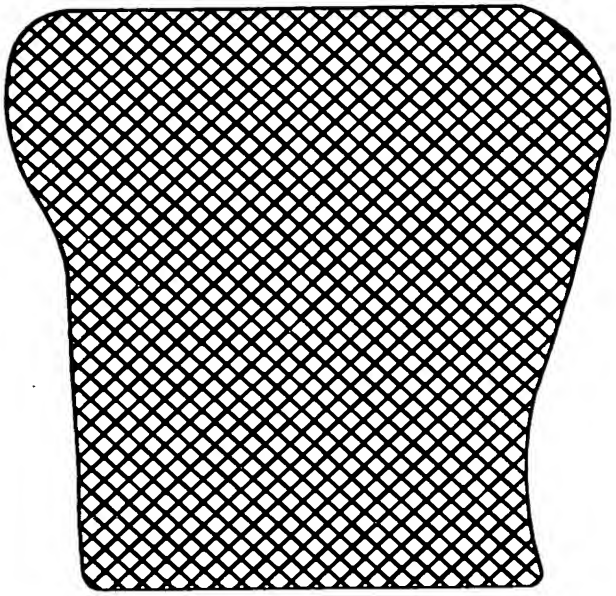


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Fig. 8

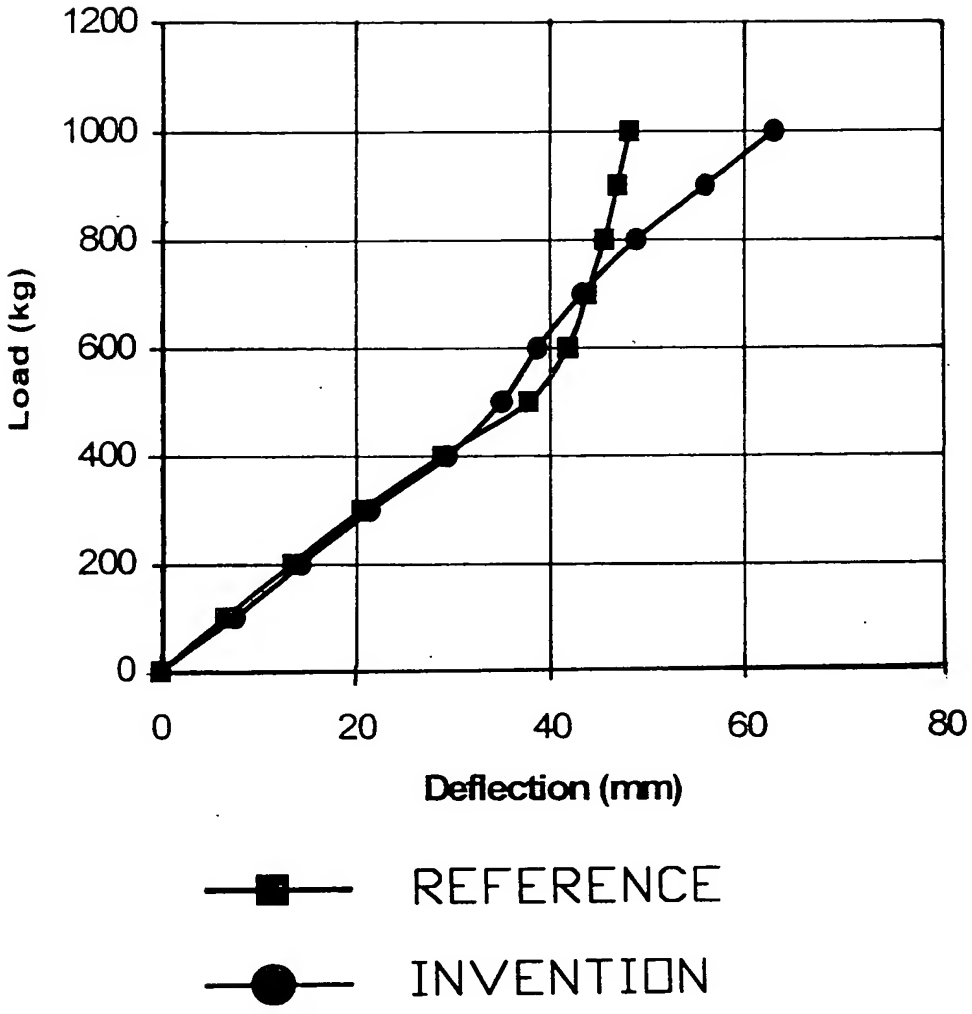
1200
1000
800
600
400
200
0
Load (kg)
0
20
40
60
80
Deflection (mm)
REFERENCE
INVENTION

Fig. 9